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USER-ORIENTED INFORMATION SYSTEMS FOR STATE AND LOCAL GOVERNMENT

by

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ABSTRACT

Potential state and local government users of information systems are classified in terms of categories of activities and levels of organizational function. The general information requirements of these users are described and categorized in terms of basic system capabilities. The existing situation in state and local government information systems is then described, indicating a need for more advanced, user-oriented techniques. Such methods and techniques currently available or under research and development are then surveyed. Brief descriptions are given of basic ideas or operating principles, along with reference to more detailed documentation. The paper concludes with several recommendations on how best to maximize transfer of knowledge, evaluate new procurements, and carry out new system design.

INTRODUCTION

This paper discusses user-oriented information systems for state and local government. Two aspects of that subject merit a few definitional remarks. First, with respect to information systems, it is accepted as given that state and local governments are experiencing greatly increased information processing needs. As population and service demands increase, government agencies are facing expanding requirements to collect, manipulate, retrieve, and report relevant information to support operational, administrative, and policy-making activities. The electronic computer has become an important tool in satisfying those needs. In fact, without engaging in statistical rhetoric, it can be safely asserted that the use of computers in state, local, and federal government, is presently increasing at almost a geometric rate. When we speak of information systems in this paper, then, we will mean the use of computers and associated equipment, integrated with manpower and procedures applied to the broad range of information processing tasks.

Second, we should define what we mean by "user orientation." The use of information systems is not a foreign concept to state and local government. Many agencies have employed various business machines, tabulating equipment, and some computers for years. However, as we will show later on, the past exploitation of computer-based systems has been limited to certain easily defined applications, and has left many potential users unsatisfied. Furthermore, early techniques of utilizing computers required an intermediary known as a computer programmer to translate particular problem requirements into instructions acceptable to the machine. Supporting information systems were primarily oriented toward the programmer's needs and only secondarily toward satisfying those of the user.

Today, however, a new trend in computer-based systems can be identified. The builders of both hardware and computer program systems and procedures (software) have recognized that systems should be more user-oriented; i.e., the ultimate users of the information should be able to communicate more directly with the information system to maximize its usability and availability.

This paper is an attempt to describe some of the work on user-oriented information systems, and to acquaint those outside the information processing field with some of the potential applications and benefits arising from such systems. We have concentrated on state and local government examples; however, the reader may see possible applications of these techniques to other activities.

The paper is organized as follows. The first section defines some of the potential users of information systems. The second section discusses what these users may want in terms of information processing support. The third section describes the existing situation in state and local government in the use of computers to satisfy such needs. The fourth section explores what kind of support can be expected from the user-oriented systems. The final section gives recommendations on how to proceed from this point to make the required transfer of knowledge and techniques.

A list of pertinent references is also attached. The numbers in parentheses throughout the text refer to citations from that list.

I. WHO ARE THE USERS

In state and local government, there are three major categories of applications of an information system. The first category includes operational departments dealing with substantive "technical" problems. Some examples at the local government level are city and regional planning, health, police and fire protection, building and safety, sanitation, and public works. At the state level applications would include motor vehicles, agriculture, water resources, justice, public health, and social welfare.

The second category comprises administrative support and fiscal activities. At the city level applications would include functions of the controller, city administrative officer and city clerk, as well as tax assessment and billing, and centralized logistic support such as motor pools, etc. At the state level this category would include the state controller, general administrative services, finance department, and tax boards, among other applications.

The third major category is policy making. This category includes policy bodies and elected officials, such as mayors, governors, legislators, county supervisors, and city councils.

Within each of the three areas there are different levels of user interest in information, generally corresponding to organizational function. (1) The policy-making level. This includes the administrators, or public officials. (2) The managerial level. This includes the line managers of operational or support activities. (3) The technical level. This includes the substantive area specialist or staff person, usually a non-computer programmer. Examples are investigators, city planners, traffic engineers, public works engineers, administrative system analysts. (4) The information specialist level. This includes computer system specialists, programmers, tabulating machine supervisors, and operators.

In building an information system, it is necessary to satisfy this wide range of possible users. It is obvious that the user's position and immediate interest will dictate what particular relationship he would like to have to the information system, and what he expects in terms of its performance.

II. WHAT DO USERS WANT

A brief description follows of the general requirements of the different levels of users referred to above.

Policy Makers

Policy makers generally have a need for staff work to be done rapidly and with great flexibility. They require summarizations of specific data; for example, in making a zoning decision, they might wish to know in a concise fashion the existing zoning situation in the area. They want predictions of population and economic trends in order to establish potential requirements for facilities and financial resources. They want specific facts to counter or support criticisms from constitutents of particular behavior on the part of the government. Generally speaking, these are not standard or fixed requirements. Some may be standardized for a short period of time, but usually the policy maker changes his mind about what he would like to see and in what form he would like to see it. The ad hoc requirements for information are then translated by staff people into specific information retrieval requests to an information system which may not be able to respond flexibly. For example, in some cities, the actions of the city council are recorded and maintained in a manual file with cross-indexing on subject, person, and location keys. The manual system operates quite well in support of most standard requests. From time to time, however, the councilmen express a desire to retrieve information on subject categories which have not been pre-indexed in the manual system. In those cases, unless the great expense of a chronological search can be tolerated, the information may not be available to the requestor.

Managers

Line managers, whether in operational or support areas, generally have similar functions to perform. These functions include:

Planning. For this they need data available on past performance of their agency and the prediction of future demand.

Resource Allocation. Usually, resources are limited and the manager would like to be able to evaluate different manpower deployment or other resource allocation plans depending upon the prediction of future demand.

Monitoring. Here the manager is interested in a statistical reporting system for monitoring of lower level activities. In designing such a system, it is important to note that the manager should not be inundated with large blocs of raw data. Any automatic system of reporting should provide him with the amount of analyzed information he is capable of assimilating.

Error Correction. By this we mean the activities the manager undertakes to alleviate problems detected through monitoring. Obviously, the ability of the manager to accomplish error correction may depend upon his personal qualities, organizational position, and political support.

In some ways, the manager's information requirements are similar to those of the policy maker. The manager also needs to be able to summarize rapidly across various files of data in the system. Furthermore, he needs the ability to ask the information system non-standard questions on an ad hoc basis and get rapid response.

Substantive Specialists

There are four basic kinds of capabilities required for different substantive needs.

1. For some agencies, obtaining operational data on a real-time basis is an important user requirement. A significant application is in the law enforcement field. The field officer must be supported by communication and information systems that enable him to determine if, for example, a given vehicle is stolen or if a given individual is wanted for a particular crime. Another example is the emergency dispatching of fire equipment. Here the dispatcher must make a rapid response to a request for assistance. He must determine the specific location of the fire and allocate the appropriate equipment. Compounding these problems, of course, is the complexity in making overall deployments of scarce resources. This problem is typical of emergency services such as fire and police.

   The important thing to recognize about these examples is that real-time operational data systems need to be designed to service the user. Because the user is generally not mathematically trained, but rather, is an operational officer or commander, any computer-based system must interact with the user in the most natural language or display technique possible. This principle is being explored specifically in the Los Angeles Police Department work described in References 20, 21.

2. A second need is in the administrative and fiscal area. Here the computer support must be provided for very large volume administrative processes, such as tax billings, street improvement assessments, notification of zoning changes and budget preparation. Some of these activities, such as the billings, assessments and notifications, are quite repetitive processes. In building computer systems to support repetitive processes, significant efforts should be made to minimize the amount of operational computer time required. However, in such an activity as budget preparation, a different problem exists. Here the primary cost is for analytical and clerical man-hours in continuously repeating and making minor adjustments and changes to initial budget requests. Computer support for this type of application should seek to minimize the amount of intellectual effort and clerical support required. This calls for a flexible system that will allow continuous changes to an existing budget data base.

3. A third type of capability is in analysis and prediction. Examples of computer systems' potential in this area may be seen in transportation planning, the evaluation of housing requirements, the monitoring of health conditions, the analysis and detection of potential blighted areas in urban analysis, and in the engineering calculations required to support highway departments, public works projects, and building and safety activities.

4. The fourth capability is one that is generally ignored in much state and local government use of computers. This is the ability to do research in specific substantive areas. Examples include questions of computer aids in education, educational facilities and curriculum planning, research in better crime detection techniques, the identification of significant variables in regional planning, and exploration of the dynamic relationship between transportation facilities and commercial and residential land use development.

Information Processing Systems Specialists

Information processing specialists require two basic types of support from computer systems. A major activity of the system specialist is to analyze the problem with which he is dealing and process-chart the activity. As problems get more and more complex and areas of interest grow in scope, this problem analysis and process-charting activity on a manual basis becomes very difficult. Computer-based systems can provide aids to this process to assist the system analyst.

The second major support is in the actual programming of systems. Aids might include high level programming languages or "compilers"; utility routines to assist in the preparation of programs and data storage; experimental vehicles for rapid testing of new ideas; and computer aids in checking out or "debugging" the computer programs that are being developed.

Summary of Capabilities Required

Dr. Donald Drukey, in his article on User-Oriented Programming Systems (12) summarizes these overall needs in terms of four basic capabilities.

1. The first capability is a control or "executive" program. This is essentially a traffic manager in the computer system that enables the rapid restructuring of system operations according to the needs of the user.

2. The second capability is what has been called a "data base system." In its most elemental form, the data base problem concerns the structuring of files of information in order to maximize the efficiency of retrieval of that information. For example, suppose a tax assessment file is structured in terms of the street address of the assessed property. Later, you may wish to retrieve information about any property that has certain specific characteristics, such as "a minimum assessed value of $10,000." With standard retrieval systems, unless such an index key has been incorporated in the file structure, you will not be able to retrieve the data. Manual files exhibit this problem most seriously. For example, historical files of building permits, organized by building permit number, do not enable retrieval on the basis of area location.

   As Drukey says, "What we need is the capability to go in after the fact and add things to the file, delete things from the file, and rearrange the way it's organized. Today, this is done by calling a programmer and saying, 'I made a mistake, let's change it.' And days, weeks, or months later the change comes into being. It is, therefore, important to build a flexible system that the user can talk to in his own language. The user, then, is going to interact with this system. He should be able to talk to it in his own language--language that he, the keeper of the data (not of the machine, but of the data), understands. And he should be able to say, 'I want to add something and this is what I want to add. I want to delete something. I want to change the way this is organized. I want to be able to make requests like these.' He should be able to say words like these and have the computer programs interpret these words into effective changes in the data base itself."

3. The third requirement of the user-oriented information system is in the area of displays. Drukey continues, "Display is a very personal thing. The format that conveys a great deal of information to me may be very ineffective at conveying information to another. We found this, for instance, in the case of trying to deal with a librarian. We were trying to convey to him some information as to how money would be spent as a function of time. For an engineer, the natural things to do are to plot a curve, to draw a graph, so we plotted dollars vs. time. It just happened that this librarian did not like the graphic presentation and he really could not understand what the curve meant. So instead, he said, 'let's see a table--dollars-time.' For him, that was the effective way to convey the information. For me, the curve is the effective way to convey that information. It's obvious, therefore, that our user has got to have some flexibility. He's got to have the freedom to say, 'I want to change the way in which I get these data and I want to change the data that I put together on the display.' He needs to be able, on his own, without any interaction with anybody else, to say, 'This is the way I want my display.'"

4. The fourth requirement is, of course, in the area of analysis or, as Drukey calls it, computations on the data. "So I find that in addition to the data themselves and the mechanisms for displaying things, I need a mechanism to generate things from the data that are not explicitly present. In other words, I need to be able to perform computations on the data. And again, I need the same kind of flexibility. I need to be able to say, 'I want the total of these numbers. I want the average of these numbers. I want this number divided by that number and all of those things averaged,' and so on. Once more I need to have the user able to operate with the computational programs,...flexible programs that allow him to do all kinds of things he did not anticipate he would want to do in that particular combination."

"So I have, then, four elements here, the central executive and three user functions. As we look at this we find that not only is each of these basic user functions something that we need to do, but they have to be made to work together. The display works on data that is retrieved from the data base and that may be processed by some computation before it's displayed. It is through the central control mechanism that the interaction is achieved. What that means is that each one of these little subsystems--data base, display, computation--must interact with the central one--control."

Dr. Drukey has articulated the general capability desired. Now, what is the real situation; where are we; what is available; where should we go; and how do we get there?

III. WHERE ARE WE

Historically, state and local governments' use of computers has developed under three constraints. First, the state and local government administrator operates in a highly cost-conscious environment. There is strong competition for budgetary funds. Accordingly, where computers have been incorporated into operations, the emphasis has been on making these applications demonstrate their self-supporting capability. That is to say, if a new computer was required, cost savings had to be demonstrated in order for the computer system to be approved.

Second, the constraints of the civil service system, especially with respect to salaries for technical people, have restricted the ability of state and local government agencies to compete with industry for high-level technical staff. Because of this constraint, the people who have been recruited have not always represented the more experienced computer specialists. As a result, some of the technical advancements in the field, especially advancements being made under defense contracts, have not been absorbed by civil government as rapidly as might have been hoped.

Third, the operational nature of governmental agencies, including the pressures of the day-to-day activities and the operational justifications required for budget allocations, have not permitted much research and experimentation in information systems. It is the research and experimentation that leads to technical advancement.

The result of these constraints has been a tendency toward the incorporation of two major types of applications of computers in state and local government. The first is the off-line, repetitive type of scheduled job, such as payroll and accounting systems, tax billings, license records, and standard periodic statistical data summaries. In these applications there has been a heavy emphasis on economy of machine processing time, and relatively long turnaround times typical of off-line scheduled operations have been experienced. Furthermore, the outputs of the various programs do not reflect much flexibility, either in format or content. Any change is usually accompanied by a high cost of reprogramming.

The second type of application is engineering calculations. These advanced techniques have been more easily assimilated by state and local government because of the computer's early development along these lines, and because the techniques are in use in the colleges and universities whose graduates are recruited for civil government engineering jobs.

In general, however, the present use of computers in state and local governments only begins to satisfy the existing users, and hardly attempts to satisfy the potential users throughout the various levels described above. A new approach to information system development for state and local government is required. As we have mentioned, this approach is now being implemented in several places in the U. S., primarily under military contracts, and is variously identified as "implicitly programmed," "generalized" or "user-oriented" systems.

IV. WHAT IS AVAILABLE

In this section we will describe some of the techniques for employing the computer in a more user-oriented fashion. We will try to indicate for each technique the general level of availability; that is, is it presently operational, is it under development, or is it feasible only on an experimental basis. There are many ways in which this discussion might be organized but we have chosen to describe the different techniques as they might apply to different users of the information systems.

Systems to Support the Administrator, Manager or Policy Maker

The individual at the high managerial or policy level will of course reap the benefits of any overall information system for his department or agency. Some of the techniques to support such an overall system are described below. However, there is a need in some applications to support the manager or his immediate technical staff with question-answering or display devices. Such devices are being experimented with at the present time and do not yet represent an operational capability; however, it is clear that the state-of-the-art will ultimately support such applications.

A survey of developments of question-answering systems may be found in Reference 32. One basic approach is to build a computer-stored file of relevant encyclopedic or other information. The retrieval request is posed to the file in the form of an English-language question. The computer system analyzes the question for content and form and then searches its file for the appropriate sentence, paragraph or article that provides the best answer. The SYNTHEX system development (31) has reached the point where 30-second response time to English questions of an encyclopedic file is now actually being experienced. However, some problems of syntactical analysis still need to be solved.

A second approach to the personalized retrieval problem is in the area of displays, as described earlier by Drukey. This work is much less advanced in state-of-the-art; however, experimentation in several places across the country (10, 22, 29, 33) indicates that a general purpose display system is a feasible objective.

Systems to Support Substantive Area Specialists

Some of the approaches in this category are past the developmental stage and actually are operational.

Operational Systems. Reference was made earlier to an experimental system now being tested in which Los Angeles Police Department officers can accomplish crime pattern recognition and information retrieval by means of English-language inputs to a computer-based file at a remote location. Work is being done at the University of Pittsburgh on an English-language information retrieval system dealing with legal data, both statutory and case information (17, 18). The concept in both of these programs is to eliminate artificial pre-coding requirements and make it possible for a substantive specialist, rather than a computer programmer, to make inquiries of the file in a language as close to his natural language as possible. A particularly significant advantage of this approach occurs where the initial inquiry to the file obtains negative results. Additional, refined requests to the file must then be attempted to seek more relevant information. The natural language retrieval system, embracing none of the restrictions of a pre-coded system, will accept re-phrased information requests, thereby approaching the structure of the original data from different directions.

Statistical Data Support Systems. In many activities it is necessary to collect large amounts of information, manipulate this information in different file formats, and analyze and summarize on different statistical bases. A good example is the transportation study requirement for analyzing residential locations and trip destinations. This requirement is complicated by the many variables about which data must be collected, stored, manipulated and analyzed. As this large data file evolves, different requirements for collection and analysis are generated. These requirements cause severe cost and time delay problems when specific computer programs must be produced for each new requirement. A generalized system of statistical analysis and data file management designed to alleviate these problems is now operational (2). The concept was originally developed in the Penn-Jersey Transportation Study and work was completed jointly with SDC and partially sponsored by the Bureau of Public Roads. This system provides a flexible specification language that enables complex processes to be performed with a minimum of programming knowledge on the part of the user.

Generalized Programming Systems. There are several generalized programming systems already operational (5, 8, 9, 13). The basic approach is to provide a computer system that will accept general English-language commands such as:

LOAD one file from another

SORT a file into a specified order

SELECT records by applying certain criteria

MATCH and MERGE two files in a particular way

PRINT certain raw or processed data items in a specified format

These commands are accompanied by general descriptions of the data file to be processed. The computer system then accepts the commands and the description of the data and proceeds to "program itself" to perform the operations specified.

The advantages of the generalized programming systems are primarily in the saving of manpower time, and in the reduction of computer time for program checkout. Production computer time is slightly increased compared to a specific program. Thus, it is clear that where repetitive computer processes are involved, more efficient use of computer time can be obtained by building specialized programs. However, where there are likely to be changes in the output requested or in the form and content of the input data, and where the problem is sufficiently complex so that analyst and programmer time plus computer checkout time are a reasonably high percentage of the cost, the generalized program shows significant advantages over individual, specific computer programs. A further and most important advantage is that the generalized program system does not require the level of training and expertise in computer programming that the specific systems do. Accordingly, a non-programmer can learn to use such a system in a few weeks and can apply it to many problems that otherwise would go unsolved.

Simulation and Experimental Systems. There are many problems connected with an operational activity which cannot be addressed in the real-life situation within reasonable budget and time constraints. Simulation as a technique for research, operational design and system training has been proven to be most effective (1, 11, 16, 24, 26, 27, 34). Several generalized simulation models have been developed to assist the substantive area specialist in designing and conducting a proper simulation experiment. A good example of this approach is SIMSCRIPT (23). In using SIMSCRIPT, a standard specification language is employed to describe functions and insert parameter values for the projected system to be simulated.

Time-Sharing Systems. The concept of time-sharing is being employed increasingly throughout the entire information processing field (7, 28, 30). By time-sharing we mean the simultaneous use of a central computer by multiple users, each operating a different computer program, communicating data and instructions to the machine from remote locations, and

receiving on-line responses. Each user has his own input/output device such as a teletypewriter. Graphic displays are sometimes available on television-type cathode ray tubes. Also, other small computers can be linked to the prime central computer to expand their own capability.

The sharing is accomplished by means of an executive system stored in the central computer. This executive system calls for the processing of each user's program in turn in fractions of a second. If additional processing time is required, the interim results are saved until the user's next turn, a few seconds later. Thus, to a man sitting at his keyboard, it seems as though he has almost complete monopoly of the computer, while in actuality many other users are simultaneously experiencing the same phenomenon by virtue of the very great speed of internal computer processing. Also, by overlapping multiple users' input/output operations with computation time, the utilization of the central computer is maximized and individual user cost is reduced. Time-sharing has obvious implications for the entire range of user-oriented systems described in this paper.

Systems to Support the Computer Specialist or Programmer

Most of these systems are presently operational. High-level compilers such as JOVIAL, COBOL, FORTRAN (6, 19, 25) are now available and have greatly decreased the amount of time and effort expended by the computer programmer. In addition to these specific programming languages, the Generalized Programming Languages described above are available for a programmer's use in satisfying non-production, non-standardized information processing requirements.

The time-sharing systems provide an ability to do on-line checkout and debugging of computer programs. This has greatly increased the programmer's effectiveness. He no longer has to wait for an 8 to 24 hour turn-around time to see the results of his last test. He now gets immediate feedback from an on-line system and thereby reduces by an order of magnitude the total time to check out a computer program. He also has certain utility aids available so that he may construct data files and edit tapes of both programs and data on an on-line basis (3). Rapid, on-line programming for small subroutines is also made possible by means of interpretive system programs that accept his instructions and immediately give him an opportunity to execute and test his approach (4).

For the system designer, techniques are being developed that provide semi-automated support to the analysis and design process itself. The AUTOSATE System (14, 15) is an initial attempt to utilize the computer in analyzing the content, origin and destination of information media flowing through an existing system.

V. WHERE DO WE GO FROM HERE

Thus far, we have presented quite an optimistic picture of the potential benefits that can accrue to civil government from advanced developments in computer systems. Before presenting some recommendations on how to proceed from this point, a word of caution may be of value.

Although all the systems described here are general with respect to the user, many cannot be easily transferred from one type of computer to another. Some techniques, still in the experimental phase, need to be further developed and adapted to applications in state and local government. The problems of governmental applications may be sufficiently different from those for which the techniques were designed so that some modifications may be necessary to obtain best results. Cost constraints may also interfere, as we have noted earlier. Nevertheless, the user-oriented systems are of overwhelming value. Somehow we must find a way to make the necessary transfer of knowledge and techniques to the state and local government community.

There are three classes of recommendations that can be made to ease this transfer of knowledge over the next few years. The first class concerns the technical information problem: How can the state and local government agencies obtain information on what systems are applicable to their own problems, and what work needs to be done to adapt new approaches?

The second set of recommendations concerns modifications in the method by which cost and effectiveness of potential new systems are evaluated: What changes in approach are required to make it easier for advanced techniques to be incorporated in the new systems being procured?

The third group of recommendations concerns the actual processes of system design itself: What principles of system design should be observed to maximize the cost/effectiveness of a new system?

Maximizing the Transfer of Knowledge

If the maximum transfer of knowledge and techniques to state and local government is to be made, it will be necessary to modify certain attitudes and approaches that presently exist. First of all, the technical person responsible for information system development in a given agency should represent a high technical-managerial capability. Such a person is difficult to attract unless the salary position available is at least mildly competitive with industry. A change in existing civil service salary structures is certainly difficult to bring about, especially when the general level of

salaries for non-technical administrative positions frequently falls short of industry's salary level for non-supervisory technical people. Nevertheless, the problem must be faced and attacked.

Second, these technical people must be given more freedom in terms of professional association outside the civil government sphere; specifically, attendance at meetings of organizations such as the Association for Computing Machinery and Operations Research Society of America should be encouraged and financially supported. It is through this type of professional association that the more advanced techniques are often introduced, discussed, critiqued, and modified.

Finally, the technical people must also be given a certain amount of time to experiment with techniques that fall outside of the immediate day-to-day job needs. It is a fairly well recognized phenomenon in system development that, as new capabilities are made available, more and more uses, previously unknown, come to light. The more applications a given system services, the lower the overall cost of governmental operations. However, these new applications for existing state and local government information systems cannot be uncovered if sufficient time to experiment with potential new applications is not provided.

Modifying the Procurement Evaluation Criteria

The rising costs of government and the problems of obtaining new revenues to support increased demands are well known. It would seem at first glance that the recommendation we are about to make here aggravates that pragmatic situation. In actuality, however, our recommendation should serve to ameliorate the high cost problems. We are urging that procurement of computer systems and other new technological advances be evaluated, not on the basis of immediate cost savings of equipment and clerical positions, but rather, on a more broad basis and with a longer time dimension for comparison. We assert that one of the problems connected with the increasing service demands and higher costs of government is in the short-sighted financial evaluations that are performed. More and more, it is becoming clear that the salaries of substantive specialists, and the requirements for more of them, continue to rise despite the addition of computer systems. Merely saving equipment and clerical costs obviously does not address the more fundamental problem, the use of substantive staff. Savings in effectiveness of analytical and specialist time may very well balance any additional investment in hardware or software. The generalized program system approach is the most obvious example here, but there are many others. Our thesis, then, is that while cost savings should be one of the primary criteria for evaluating new procurements, the past definition of what costs include has been too limited. Systems ostensibly producing "cost" savings have in many cases actually resulted in increasing costs of overall operations.

We grant the difficulties in convincing administrative budget officers of the accuracy of our contention; yet, some modification in approach must be made if state and local agencies are to survive the increasing volume and complexity of information requirements.

Recommended Approaches to System Design

Having provided the best professional and economic atmosphere in which new systems can be designed, there are still some recommendations that can be made in terms of the actual design process itself. These are well documented in the system analysis and design literature and may be briefly summarized as follows:

1. To avoid perpetuating the shortcomings of an existing system, do not merely automate present procedures. Rather, consider new ways to obtain the desired outputs by exploiting the advantageous features of computer systems.

2. Develop a system that operational personnel can communicate with and actually utilize for their operational needs. The administrative and clerical components are to support the agency's overall objectives, and should not dominate the information system design configuration.

3. Search for and incorporate the most advanced concepts and techniques that are available within development time and cost constraints. This is the basic philosophy behind this paper.

4. Recognize the impact of new technology on operations, organization, and procedures. Existing divisions of labor and methods of operating may no longer be valid as computer systems are introduced. An appropriate management climate for modifying traditional approaches must be provided in order to maximize the benefits to be obtained from new technology.

In summary, we have described some of the potential benefits of user-oriented systems, and have discussed some problems in present state and local government approaches to information system design and development. Some modifications in approach have been suggested which should speed the transfer of knowledge and techniques to the civil government community.

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